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T. H. HOSKINS, M. D., Editor.

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METEOROLOGY.

An Epitome of the Paper read at the recent meetings of the Vermont Board of Agriculture, at Brandon and Randolph.

BY HIRAM A. CUTTING, A. M., M. D.

Mr. President, Ladies and Gentlemen:

As an introduction to meteorology it becomes necessary to speak of our atmosphere, the invisible fluid which surrounds our earth to a height of more than fifty miles. Invisible, yet of a beautiful blue color, imparting light and heat in a great degree to our earth, causing a general dissemination of vapor, as well as in itself being indispensable to animal and vegetable life. Widely as it is now known that the atmosphere exists, ludicrous as it would seem to deny its existence even to the merest schoolboy, it is of comparatively recent discovery. Two hundred and fifty years ago the individual that had declared its existence would have been supposed a raving maniac. All the phenomena it produces were explained upon other principles, some of them in ludicrous manners showing the wildest theories and the most absurd ideas. The creation of the atmosphere as declared in Genesis as the firmament dividing the waters, was not understood. A vague and unmeaning explanation was given it. When it was discovered that there was in reality an aeriform fluid surrounding the earth, possessing weight, color, power of generating and imparting light, pressing upon our bodies at the rate of fifteen pounds to the square inch, and that very pressure necessary to our existence, that without it our arteries, even all the tissues of our bodies would burst asunder. However common it is to speak of it at the present day, it then struck with wonder and astonishment all the learned throughout the world. So wonderful and incredible did it at first appear that it was not until after the lapse of several years, till opinions which had prevailed for ages were overthrown, and the most decisive experiments had been performed in every possible way, that it was cordially received.

This atmosphere is composed mostly of two gases, nitrogen and oxygen. It was, however, less than sixty years ago supposed to be a simple body. Oxygen is the supporter of animal life, while the nitrogen is thrown off by the animal, to be in turn absorbed by the vegetable, and thus goes on silently a systematic purification. But if this atmosphere was stagnant, some portions would be pure while others were deleterious. But here we see God again directing the wind and the storm, thereby purifying and mixing its gases. We know wind is air put in motion, this of course could not be known when it was not known that we had an atmos-

phere, so by the ancients entirely different causes were supposed to produce it.

Pliny, one of our greatest historians, being thoroughly reliable as regards the facts of his day, says, "In houses there be hollow places devised and made by men's hands for receipt of wind, which being enclosed with shade and darkness gather their blasts." Thus in the time of the ancient Greeks, in the time of renowned men that invented an architecture or manner of finish, which has been handed down and used to the present day, building their houses and stately edifices with curiously contrived cavities on the outside as a resting place for wind. Wind, to their minds, was a spirit needing their provision, and one to which they did not wish to give offense. Caves were places of superstitious dread, as they were supposed to be the resting places of wind, and finally became of use to the freebooters, as they were thus comparatively safe from the law. The origin of wind as taught to their youth, and handed down to us in their ancient manuscript school-books, is this: "There be certain caves and holes in the earth which breed wind continually without end. They have wide mouths, and if you cast in anything of light weight, it will be seen presently to come out with a stormy tempest. Thus you can see how all winds have a cause." That all winds have a cause we are ready to admit, but that they understood that cause no one of sound mind can now believe.

As the first principles of meteorological science, it becomes necessary that we should look to the causes and effects of wind. Wind is defined in our school books as air put in motion; such motion is generally attributed to heat. Thus, as the air becomes heated, it rises, because it is rarified, and cool or more dense air rushes in to supply its place. During the day the air is heated by the sun and rises, cooler air coming from the west supplies its place, because at the east behind the sun the air is more heated; this, were there no other conflicting causes, would cause a strong west wind during the day, and a mild east wind during the night. In this section this cause with the lay of land slightly changing it towards the northwest, giving us a west, northwest wind as many days as we have from all other points together. Near the ocean the land becomes heated by the direct rays of the sun hotter than the water, causing a breeze blowing inland during the day. At night the earth parts with its heat much more readily than the ocean, so the current changes, blowing seaward during the night. This creates the general winds of our coast called land and sea breezes. But so far inland we feel little effect from that cause.

Another great modifying cause is evaporation. That silent power ever present and always going on. That power which dries our clothes, seasons our wood and lumber, and without which this world would be uninhabitable. Did you ever think that if God should withdraw this power from earth, everything would be always wet? That fire would not burn, and your clothes, once wet would never be dry again, in fact, that it would reduce the world to a wet, slimy, uninhabitable globe of filth? But by the kind dispensation of that overruling power we have an evaporation sufficiently powerful to raise about two thousand gallons of water per day, during the summer months, from every acre of land and nearly double that amount from the same surface of water. As the heated air rises, it takes up with it a greater amount of water than can be held in solution at a lower temperature; this when it strikes a colder stratum in the higher atmosphere is condensed into clouds, these clouds changing and impeding the currents cause wind, sometimes severe.

Electricity, that subtle agent ever present in the atmosphere, being beyond the comprehension, and almost beyond the control of

man, doubtless exerts great power, as in almost all tornadoes it is visibly present, and unusual changes in atmospheric electricity prognosticate uncommon gales.

I might also speak of other causes did time permit, which produce changes doubtless causing wind, but as throwing a pebble into a pond of water creates more or less disturbance in the entire mass, so in the atmospheric air being much lighter and more elastic, the smallest causes being compensated by others are sufficient to produce currents and eddies, sometimes of much force and effect. Though all parts of the earth's surface have atmospheric currents of more or less effect, there is great contrast in different sections. The northern half of the Connecticut River valley, shut out by the White Mountains on the east from the oceanic currents, and by the Green Mountains on the west from the strong west winds of the continent, our aerial currents are strictly local and of mild force. The winds prevalent around Lake Champlain, even, would be considered extraordinary gales here, while in many sections of our fertile west the wind blows every day so as seriously to impede labor; while in many places peculiar winds and violent hurricanes pass, frequently causing great inconvenience, and many times fearful loss of life and property. Though our quiet state is seldom visited by tornadoes, there has been a sufficient number to show that we are not exempt. Upon the third of July, 1832, there was a tornado in the town of Victory of remarkable force. Its devastations commenced upon the top of a high hill in that town where its path was only a few rods wide, but it gradually increased to about one-half mile in width, sweeping every thing before it for about two miles, when it began to lose its power. Its track was a forest, yet it not only tore up the trees but the soil also, piling it out with the twisted and broken trees in huge rows near the place where its fury seemed spent. The noise of this tornado was heard for more than ten miles, and was supposed by many to be an earthquake. It was accompanied with heavy thunder and incessant lightning with torrents of rain. If this had swept through one of our villages we could hardly imagine its devastations, yet history tells us such things have been. In 1703, London, now the metropolis of the world, was blown down, and its shipping, consisting then of over 1200 sail, was totally destroyed. Thousands of persons and tens of thousands of cattle, sheep and horses perished. The whole amount of damage done could not have been less than the amount of our national debt. Yet England recovered from the blow, and London is now the metropolis of the world.

We also have in some sections noxious and poisonous winds, but these generally prevail in southern climes. Our atmosphere, aided by the causes that produce wind, is destined by the Creator to distribute moisture to the earth, giving it fertility. The most simple form of distribution is that of dew. This is the humidity of the atmosphere deposited on surfaces with which it comes in contact. During the day the solid portion of the earth becomes more heated than the atmosphere, and gives off moisture by evaporation. This continues to go on until the solid portions become cooler than the air, then this moisture is in part condensed on the solids forming dew. Dew can be artificially formed at any hour of the day, as for instance,—take a pitcher of ice water or cold spring water, and place it in the open air or in a room in your dwelling, and the outside of the pitcher will in a short time be covered with drops of water. The general term given is that the "pitcher sweats," and some even suppose that the water sweats through the pores of the pitcher, but such is not the case; it is dew the same as deposited on the grass or ground, and from the same cause. Warm days and cool nights are favorable for large

dews. I might almost say fair nights, for cloudy nights are always cooler, and sometimes, and in fact often, cool the atmosphere as fast as the earth cools, in which case there can be no dew. The atmosphere always contains more or less aqueous vapor in an invisible form. This vapor is water dissolved in it, in the same manner as salt can be dissolved in water without changing its transparency. As warm water will dissolve more salt than cold, so will a warm atmosphere dissolve more water, or in others retain more vapor. If the temperature is depressed the vapor appears in the form of clouds. If greatly cooled it will fall as rain, hail, or snow. This principle of evaporation and deposit of moisture now so generally understood and so thoroughly demonstrated, was once like all other points in meteorology considered as beyond comprehension and attributed to supernatural causes. Horace speaks of dew as a gentle, evening shower without clouds. Virgil says that every night we have a misty rain. Pliny of the falling dew, and even at the present day how often do we hear the expressions about falling dew, showing that though we understand the method or way of deposit, we are not entirely free from the idiom of expression founded on the mystic reasons of past ages. Some countries are rendered productive and even fertile by dew alone, and doubtless this to the ancients being so mysterious, being deposited in greatest abundance when most wanted, and of vastly more importance to them than to us, caused them to regard it as an express gift of God, as the manna in the wilderness, by his hand, but not in accordance to the laws of nature. In the minds of those people it possessed wonderful virtues. It was supposed if a man sipped the dew and drank no other beverage he would possess new vital energies, and live on earth a long period if not forever. Even up to the present time it is considered by some to beautify the complexion and restore the charms of youth. According to the closest observations I have been able to make, the dew here deposited amounts to about three inches per annum. It begins usually to be deposited as soon as the sun goes down and frequently before, and continues through the night. When the temperature decreases during the night to the freezing point, the dew is frozen forming frost, its destructive powers being in proportion to the intensity of the cold. Of course dew cannot be deposited only where there is moisture in the atmosphere from evaporation, so on deserts or dry unproductive places no dew can be.

The next means of disseminating moisture is by clouds; their formation I have already explained. They are not vapor, as vapor is invisible, but water. Not held in solution, but in minute particles like dust. In reality water pulverized. So light they may be readily blown forward by winds, yet ready to be condensed and precipitated as rain by the slightest causes. This condensation is commonly produced by reduction of temperature either by a cooler current of air or by electrical changes. Clouds are continually varying in their form and appearance, but may be classed under four heads. The cirrus is a light fleecy cloud resembling a wisp of hair or bunch of feathers, and is the highest of all clouds. The water it contains is of course frozen into snowy particles on account of its great elevation, and further we know it is so as aeronauts passing through it in their balloons always find it so, and its peculiar appearance is owing to that fact, as the wind blows the frozen particles about in long, wavy lines. When this cloud is seen, if it be watched, it will gradually change into a sort of dappled sky or wavy cloud and disappear, or else the length of the lines will increase and expand over the heavens; in this section the resolution into the mottled sky indicates fair weather, but the last mentioned form indicates a storm which will be likely